

# Save the Whales? Save the Rainforest? Save the Data!

Increasing public investment in conservation has been accompanied by growth in monitoring and research that is generating ever more primary data and associated scientific articles. Despite this cumulative output, it is still difficult to systematically predict the outcome of conservation actions in a given situation (Salafsky et al. 2002), even for iconic conservation targets. "Save the whale" and "save the rainforest" seem like dated expressions, but neither has been achieved and it remains unknown which interventions will effectively do so. For example, there is no consensus on whether limiting the use of sonar will prevent whale strandings or whether debt forgiveness for developing countries in exchange for conservation projects conserves rainforests effectively.

We believe this failure to develop a shared evidence base on the outcomes of conservation actions occurs in large part because the raw data needed to conduct systematic reviews of conservation actions are often missing or inaccessible and that changes in the cultures of conservation research and practice are needed to resolve the problem.

The current situation in conservation is not unlike that in medicine a few generations ago when physicians based selection and application of treatments largely on myths, anecdotes, and personal experience. In the 1980s, medical researchers and government health services in developed countries began to recognize that the lack of research synthesis limited effectiveness and efficiency of medical treatments (Chalmers 1993). Since then substantial financial and cultural investments in the development of evidence-based practice have been made. Initiatives such as the Cochrane Collaboration ([www.cochrane.org](http://www.cochrane.org)), which created a centralized repository of objective, systematic reviews of available evidence on the effectiveness of health interventions, have catalyzed a revolution in the effectiveness of the delivery of health care (Stevens & Milne 1997). As a result, physicians no longer must rely so heavily on anecdotes or spend their evenings reading the voluminous primary literature in their speciality; instead, they can stay up-to-date by reading concise summaries of the state of evidence. Nor is the Cochrane Collaboration of benefit to only developed countries. The organization provides people in developing countries access to systematic reviews, and a

growing number of reviews address the needs of developing countries (e.g., Lengeler 2004).

Conservation and environmental management is just beginning to establish comparable evidence-based approaches (see [www.environmentalevidence.org](http://www.environmentalevidence.org)). True evidence-based conservation requires collaborations among individuals and institutions that have the capacity and the resources to identify operational research topics of interest and to apply the process of systematic review to collect and critically appraise all available reports, synthesize the primary data, and disseminate their findings (Pullin & Knight 2001). But the foundation of any systematic review is access to original data. And unfortunately, today most raw data generated by researchers and practitioners are inaccessible (either protected, poorly recorded and archived, or simply lost).

Academic researchers (and more importantly their assessors) focus on outputs in the form of peer-reviewed papers, which often do not present any raw data or at best present raw data from a perspective limited to the hypothesis being tested. There is currently little or no institutional incentive for researchers to make raw data available for future use. Thus, it is commonly not feasible to "recycle" data, reexamine interpretations, correct faulty analyses (Ionnadis 2005), or use these data to inform different research questions. Outside academia the situation is no different. Practitioners typically receive little encouragement to document their findings and thus rarely do so; at best they produce reports and assessments that are not subjected to peer review, lack raw data, and potentially include a relatively high number of errors in methods and interpretation.

Inaccessibility of data is a major hindrance to evidence-based practice because it dramatically increases the cost and time of systematic review. The term *best available evidence* is frequently used in systematic review not because data are nonexistent, but because they are inaccessible. All too often, it is impossible to extract sufficient detail from published articles, reports, or even supplementary material for further analysis and interpretation. Contacting authors directly is time-consuming and often does not yield data. As a result, meta-analytical syntheses are compromised, the opportunity for rigorous evaluation is lost, and the potential of scientific data to

underpin major conservation management and policy decisions remains unrealized.

If we conservation professionals hope to apply truly effective systematic review and evaluation processes to conservation actions, we need to follow the example of other fields of study and develop a culture in which making raw data accessible to all is as important as interpreting those data. For example, biomedical researchers are required to deposit basic information in officially recognized databases before they can publish in certain journals or receive government funding (e.g., [www.ncbi.nlm.nih.gov/Genbank/](http://www.ncbi.nlm.nih.gov/Genbank/) for primary genomic sequence data and [www.ncbi.nlm.nih.gov/geo/](http://www.ncbi.nlm.nih.gov/geo/) for cellular RNA and protein expression data). Public registers of medical clinical trials are also well established (e.g., [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov)), which has created an expectation of forthcoming data from funded projects.

The development of a data-sharing culture, like any large-scale shift in human behavior, requires practitioners and researchers to have the necessary infrastructure, awareness, and incentives. Although data from conservation projects are often more complex and heterogeneous than genome sequences, conservation professionals are starting to develop the tools necessary to facilitate sharing of data from both conservation practice and academic research. For example, a standard nomenclature is being developed for both the specific threats that conservation projects face and the conservation actions that these projects are using to counter these threats (Salafsky et al. 2008). A number of software tools and databases exist that collate and store standardized data from conservation actions so that successes and failures can be shared across organizations (e.g., [www.Miradi.org](http://www.Miradi.org), [www.conpro.tnc.org](http://www.conpro.tnc.org), [www.conservationevidence.com](http://www.conservationevidence.com)). And common data-exchange standards are being developed to ensure that these databases can be cross-referenced (see [www.conservationmeasures.org](http://www.conservationmeasures.org)).

Data-sharing tools will be ineffective, however, without rewards and enforcement measures to promote their adoption and use. For example, as in biomedical research, government agencies and private donors that support conservation could make data sharing a condition for receiving funding, and they could develop public registers of funded projects and research. Teams conducting registered projects would be expected to share their data and would be rewarded for doing so. Likewise, journals could (and increasingly do) make sharing of data a condition of publication. Some professional societies (e.g., Ecological Society of America) require authors of papers published in their journals to submit data to publicly accessible databases or repositories as supplementary material. Nevertheless, a proliferation of competing databases associated with individual funders or journals, each with different reporting standards, will not solve the data-accessibility problem. A policy of concerted ac-

tion among key professional societies, government organizations, and research funders and centralization of data repositories to common standards is thus urgently required for both the science and practice of conservation.

Conservation of data initially may seem an obscure and academic exercise. But at stake is the effectiveness with which scarce resources are spent on crucial management and policy interventions. There are few interventions for which conservation professionals have collated relevant studies, appraised the quality of primary data, and characterized the evidence base. For example, the Collaboration for Environmental Evidence Library has to date accumulated fewer than 100 systematic reviews (see [www.environmentalevidence.org](http://www.environmentalevidence.org)). Consequently, instead of benefiting from systematic evaluations of what works and what does not, for most tools, conservation professionals are still making decisions on the basis of myths and anecdotes (Sutherland et al. 2004). As a result, the sum of resources squandered through ineffective conservation actions likely far exceeds the cost of reporting and sharing high-quality data (e.g., Stewart et al. 2009). Although lack of data is not the only factor limiting the use of evidence-based conservation, development of incentives and tools to create a solid base of data from which rigorous systematic reviews can be derived is key to improving the effectiveness of conservation interventions. The time is ripe to demonstrate that conservation science and practice can provide real benefits to society and that financial investments in conservation are not wasted by people or organizations that are uncertain whether their actions will do more good than harm (Pullin & Knight 2009). If society wishes to save the whales, the rainforests, and the rest of Earth's biological diversity, we first must save and share the data.

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